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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/812,339	03/29/2004	Brian Lee Lawrence	135476-1/YOD GERD:0088	2691

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EXAMINER	
SUCHECKI, KRYSTYNA	

ART UNIT	PAPER NUMBER
2882	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/812,339	LAWRENCE ET AL.	
	Examiner	Art Unit	
	Krystyna Suchecki	2882	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 April 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-51* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-51* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claims 22, 28, 35, 37 and 43 are objected to because of the following informalities: Claims 22 and 37 recite a vacuum cavity in a ring configuration. This appears to be an editing error, and for examination purposes the claim will be interpreted as having a laser cavity in a ring configuration. Claim 28 recites an electron storage ring overlapping a vacuum cavity. This also appears to be an editing error, and the claim will be interpreted as having an electron storage ring in the vacuum cavity so that the electron storage ring overlaps the path of the high-energy optical pulses. Claims 35 and 43 are objected to since there are no features recited in the claims to give antecedence to the "round trip time" of the optical pulses. For examination purposes, a laser cavity with a round trip time will be understood as present. Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-5, 7, 12, 13, 15, 16, 17, 19-23, 25-27, 45-47 and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sprangle (US 5,353,291) in view of Srinivasan-Rao (US 6,459,766), herein referred to as "SR."

4. Regarding Claims 1, 3-5, 15-17, 22, 23, 45 and 47, Sprangle teaches a system and method for generating X-rays, the system comprising: a high repetition rate laser source (22, in the form of a gain amplifier for compensating for lost optical signal) adapted to generate and

direct high-energy optical pulses in a first direction in a laser cavity (56), wherein a plurality of mirrors are arranged in a ring configuration (Column 3, line 14); an isolator (48) located in the laser cavity for directing the optical pulses in the first direction; and a source of a pulsed electron beam (16) adapted to generate and direct the pulsed electron beam in a second direction opposite to the first direction in a vacuum cavity, the pulsed electron beam impacting photons in the optical pulses in the laser cavity to produce X-rays (18) in the second direction, wherein the high energy optical pulses comprise high repetition rate, mode-locked optical pulses (Column 4, line 47). Portions of the laser cavity are "preferably" outside of the vacuum cavity, but no teaching or prohibition is given against having them in the vacuum cavity (Column 3, lines 16-18). Sprangle also teaches electron beam recycling (Column 3, lines 50-54),

5. Sprangle fails to specifically teach that the laser source is within a vacuum cavity.

6. SR teaches means to recycle an electron beam (14) while simultaneously circulating a laser beam (18) for the purpose of generating x-rays (22) in a vacuum cavity (Figure 1 and Column 2, lines 52-57). The vacuum cavity surrounds the elements for the purpose of circulating the electrons with minimal energy loss (Column 2, lines 52-57). An amplifier can optionally be included within the laser cavity boost the laser signal between mirrors (Column 3, lines 20-33).

7. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to contain the device of Sprangle in a vacuum cavity as taught by SR since the containment would allow circulation of electrons with minimal energy loss (SR, Column 2, lines 52-57). The gain amplifier of Sprangle could also be accommodated within the vacuum cavity to replenish the laser signal.

8. Regarding Claims 2 and 46, Sprangle in view of SR teaches a system and method, further comprising a plurality of mirrors (36, 26, 28, 34) located in the vacuum cavity for confining the optical pulses within the vacuum cavity.

9. Regarding Claims 7, 19, 25 and 49, Sprangle in view of SR teaches a system and method, further comprising an electro-optic cell (Column 4, lines 50-55) and a Brewster plate (36) located in the vacuum cavity for generating the high repetition rate, mode- locked optical pulses.

10. Regarding Claims 12, 20 and 26, Sprangle teaches a system, wherein the source of the pulsed electron beam is a radio frequency linear accelerator (16).

11. Regarding Claims 13, 21 and 27, Sprangle teaches a system, further comprising one or more magnets (24, 25) to direct the pulsed electron beam in the second direction in the vacuum cavity.

12. Claims 8-11 and 50-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sprangle and SR and further in view of Erbert (US 6,760,356).

13. Regarding claims 8-11 and 50-51, Sprangle in view of SR teaches system and method for generating X-rays having a stretching and compressing or gain amplification component (42) to rejuvenate the circulating laser beam from a solid state laser (Column 4, lines 1-11 and 60).

14. Sprangle in view of SR fails to teach particulars of the component such that it comprises a solid state laser rod, a Yb:YAG laser rod, a grating located in the vacuum cavity for temporally stretching the optical pulses or a grating located in the vacuum cavity for temporally compressing the optical pulses.

15. Erbert teaches an amplification system and method using a combination of a grating stretcher, a Yb:YAG laser rod and a grating compressor for providing a high average power signal (Column 2, lines 25-30) with the Yb:YAG additionally providing a long upper state storage time and low thermal loading (Column 3, lines 28-64).

16. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize an amplification system and method using a combination of a grating stretcher, a Yb:YAG laser rod and a grating compressor as taught by Erbert in the system of Sprangle in view of SR for the benefit of providing a high average power signal (Erbert, Column 2, lines 25-30) with the Yb:YAG additionally providing a long upper state storage time and low thermal loading (Erbert, Column 3, lines 28-64). The combination would provide an additional solid state laser in the system, thereby increasing the amount of laser light for the electron beam to interact with in the system.

17. Claims 6, 18, 24 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sprangle and SR and further in view of Weingarten (US 2003/0174741).

18. Regarding Claims 6, 18 and 24, Sprangle in view of SR teaches the use of a mode-locking device in an X-ray generation system and method above in order to regulate the occurrence of laser pulses (Column 4, lines 43-49)

19. Sprangle in view of SR fails to teach an acousto-optic cell located in the vacuum cavity for generating the high repetition rate, mode-locked optical pulses.

20. Weingarten teaches that it is known in the art to use an acousto-optic modulator as an intracavity element to produce short, picosecond pulses (Paragraph 2).

21. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use an acousto-optic cell located in the vacuum cavity as taught by Weingarten in the system and method for generating high repetition rate, mode-locked optical pulses of Sprangle in view of SR, since the arrangement is established in the art for the generation of short pulses (Weingarten, Paragraph 2).

22. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sprangle and SR and further in view of Antonell (US 2001/0043667).

23. Regarding Claim 14, Sprangle in view of SR teaches an X-ray beam (18) exiting a generation system through a window (54).

24. Sprangle in view of SR is silent on further directional motion of the X-ray away from the vacuum cavity.

25. Antonell teaches X-ray diverting means (Figures 1-13) wherein multiple Bragg reflectors, in the form of plural crystals, collectively provide predictable diffraction angles for x-rays to propagate towards a sample (Paragraphs 6-9) for the benefit of providing parallel or convergent radiation for a variety of applications (Paragraph 2) from a common source (Paragraph 6).

26. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the Bragg reflectors of Antonell to direct X-rays in a pre-determined direction from the vacuum cavity of Sprangle in view of SR for the benefits of providing parallel or convergent radiation for a variety of applications (Antonell, Paragraph 2) from a common source (Antonell, Paragraph 6).

27. Claims 28-30, 32-38 and 40-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sprangle and further in view of SR and Hartemann (US 6,724,782).

28. Regarding Claims 28, 29, 33-37 and 41-44, Sprangle teaches a system for generating X-rays the system comprising: a mode-locked laser (Column 4, lines 43-49 and 59-63) adapted to generate and direct high-energy optical pulses in a first direction in a laser cavity having a ring configuration (Column 4, line 64- Column 5, line 1 and Figure 2); the laser cavity further comprising an isolator (48) for directing the optical pulses in the first direction; a source of a pulsed electron beam in an electron storage ring (164) overlapping the laser cavity inside a vacuum cavity, the electron storage ring adapted to circulate the pulsed electron beam in a second direction opposite to the first direction in the vacuum cavity, the electron beam impacting photons in the optical pulses in the vacuum cavity to produce X-rays in the second direction (Column 5, lines 31-61). The (storage ring) betatron (164) stores and circulates the electron beam and includes an amplifier to accelerate the electron beam circulating in the electron storage ring (Column 5, lines 57-60).

29. Sprangle fails to specifically teach that the laser source is within a vacuum cavity. Sprangle also fails to teach a source of a pulsed electron beam adapted to feed electron beam in an electron storage ring overlapping the laser cavity wherein the pulsed electron beam originates from a radio frequency linear accelerator and wherein the storage ring stores and circulates the electron beam, and includes an amplifier to accelerate the electron beam circulating in the electron storage ring, and the round trip circulation time of the electron beam in the electron storage ring is substantially equivalent to a round trip time of the optical pulses in the laser cavity.

30. SR teaches means to recycle an electron beam (14) while simultaneously circulating a laser beam (18) for the purpose of generating x-rays (22) in a vacuum cavity (Figure 1 and Column 2, lines 52-57). The vacuum cavity surrounds the elements for the purpose of circulating the electrons with minimal energy loss (Column 2, lines 52-57). An amplifier can optionally be included within the laser cavity boost the laser signal between mirrors (Column 3, lines 20-33).

31. Hartemann teaches a system for generating X-rays having a source (11) of a pulsed electron beam adapted to feed electron beam in an electron storage ring (12) overlapping a laser cavity (26). Hartemeann's pulsed electron beam originates from a radio frequency linear accelerator system (11). The storage ring (12) stores and circulates the electron beam and includes an amplifier to accelerate the electron beam circulating in the electron storage ring (Column 4,lines 47-64). The round trip circulation time of the electron beam in the electron storage ring is substantially equivalent to a round trip time of the optical pulses in the laser cavity (Column 5, lines 4-9). Hartemann teaches the pulsed system feeding the storage ring for the benefits of system compactness and minimal jitter (Column 3, line 65- Column 4, line 12).

32. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to contain the device of Sprangle in a vacuum cavity as taught by SR since the containment would allow circulation of electrons with minimal energy loss (SR, Column 2, lines 52-57). The gain amplifier of Sprangle could also be accommodated within the vacuum cavity to replenish the laser signal. It would have also been obvious to one of ordinary skill in the art at the time the invention was made to use the source of a pulsed electron beam (radio frequency linear accelerator system) adapted to feed electron beam in an electron storage ring as taught by Hartemann in the system of Sprangle in view of SR in order to have a storage ring that

stores and circulates the electron beam and includes an amplifier to accelerate the electron beam circulating in the electron storage ring (Column 4,lines 47-64) and that has a round trip circulation time of the electron beam in the electron storage ring is substantially equivalent to a round trip time of the optical pulses in a laser or vacuum cavity (Column 5, lines 4-9) for the benefit of having an X-ray generation system that is compact and has minimal jitter (Hartemann, Column 3, line 65- Column 4, line 12).

33. Regarding Claims 30 and 38, Sprangle in view of SR teaches a system, wherein the high energy optical pulses comprise high repetition rate, mode-locked optical pulses (Column 4, line 47).

34. Regarding Claim 32 and 40, Sprangle in view of SR teaches a system, further comprising an electro-optic cell (Column 4, lines 50-55) and a Brewster plate (36) located in the vacuum cavity for generating the high repetition rate, mode- locked optical pulses.

Claims 31 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sprangle, SR and Hartemann, as taught for claims 28 and 37 above, and further in view of Weingarten (US 2003/0174741).

35. Regarding Claims 31 and 39, Sprangle, SR and Hartemann, as taught for Claims 28 and 37 above, teach the use of a mode-locking device in an X-ray generation system above in order to regulate the occurrence of laser pulses (Column 4, lines 43-49)

36. Sprangle, SR and Hartemenn fail to teach an acousto-optic cell located in the vacuum cavity for generating the high repetition rate, mode-locked optical pulses.

37. Weingarten teaches that it is known in the art to use an acousto-optic modulator as an intracavity element to produce short, picosecond pulses (Paragraph 2).

38. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use an acousto-optic cell located in the laser and vacuum cavity as taught by Weingarten in the system of Sprangle, SR and Hartemann for generating a high repetition rate, mode-locked optical pulses, since the arrangement is established in the art for the generation of short pulses (Weingarten, Paragraph 2).

Response to Arguments

39. Applicant's arguments with respect to claims 1-51 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

40. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Patent to Luccio (US 4,598,415) is of interest for teaching a tubular extension for a laser source (7) attached to a vacuum cavity (10 with 8). The laser traverses a cavity to interact with an electron beam to form x-rays (Figure 3). Knupfer (EP 0 276 437 A1) is likewise of interest for teaching a vacuum container with an electron beam interacting with a laser source (6) to produce x-rays.

41. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Krystyna Suchecki whose telephone number is (571) 272-2495. The examiner can normally be reached on M-F, 9-5.

42. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Glick can be reached on (571) 272-2490. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

43. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ks

Craig E. Church
Primary Examiner